PATENT SPECIFICATION (11) 1 472 802

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(21) Application No. 12173/74 (22) Filed 20 April 1974
(31) Convention Application Nos.
48/044 914 (32) Filed 20 April 1973
48/049 479 1 May 1973 in
(33) Japan (JA)
(44) Complete Specification published 11 May 1977
(51) INT. CL.[2] B32B 7/06 27/10 31/16 31/20
(52) Index at acceptance
B5N 0706 2710 3116 3120

1,472,802

(54) METHOD AND APPARATUS FOR APPLYING A TRANSPARENT PROTECTIVE COATING TO A SHEET

(71) We, KABUSHIKI KAISHA RICOH, a corporation organized under the laws of Japan, of 3-6, 1-chome, Nakamagome, Ota-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The present invention relates to a method and apparatus for applying a transparent protective coating to a sheet such as a photograph.

It has been common in recent years to provide a transparent, protective coating on photographs, identification cards, railroad passes, and other small sheets which are subjected to frequent use. The protective coating serves the function of protecting the sheet from mutilation and dirt. The usual procedure is to laminate a plastics sheet onto the sheet. Known methods include providing a transparent sheet with adhesive on one face thereof for bonding to the photograph. This method has a drawback in that the adhesive is not completely transparent, and partially masks the clarity of the photograph. Thermoplastic sheets may also be bonded to photographs using heat and pressure, but the thermoplastic sheets are difficult to use, and may subsequently wrinkle when cooled. Another known method is to spray or coat a solution of for example vinyl resin onto the emulsion of the photograph. Vinyl resin, however, will stick to almost anything, and is therefore difficult to handle and may also wrinkle upon curing. The apparatus for use in any of the methods described above is necessarily expensive and subject to mechanical failure.

The present invention in one aspect provides a method of applying a transparent protective coating to a sheet, comprising:

(a) preparing a composite material by forming a release layer on a heat resistant backing layer and then releasably adhering a transparent thermal bonding layer onto the release layer, the thermal bonding layer comprising a material selected from polyvinyl chloride, polyvinyl acetate and a polyamide;

(b) maintaining the composite material thus formed in a state of tension;

(c) placing the said sheet and the said composite material together so that the thermal bonding layer is in face-to-face contact with the sheet;

(d) applying heat and pressure to bond the thermal bonding layer to the sheet; and

(e) separating both the heat resistant backing layer and the release layer from the thermal bonding layer so that the thermal bonding layer remains bonded to the sheet to constitute a transparent protective coating on the sheet.

The invention in another aspect provides apparatus for applying a transparent protective coating to a sheet, comprising: (a) first means for preparing a composite material by forming a release layer on a heat resistant backing layer and then releasably adhering a transparent thermal bonding layer onto the release the release layer; (b) second means for maintaining the composite material thus formed in a state of tension; (c) third means for placing the said sheet and the said composite material together so that the thermal bonding layer is in face-to-face contact with the sheet; (d) fourth means for applying heat and pressure to bond the thermal bonding layer to the sheet; and (e) fifth means for separating both the heat resistant backing layer and the release layer from the thermal bonding layer so that the thermal bonding layer remains bonded to the sheet to constitute a transparent protective coating on the sheet.

The invention will be further described, by way of example only, with reference to the accompanying drawings, in which:—

Fig. 1 is a schematic sectional view illustrating a step in the method of the invention;

Fig. 2 is a schematic sectional view illustrating another step in the method of the invention;

Fig. 3 is a view of an identification card to which the invention is applicable;

Fig. 4 is a schematic sectional view illustrating a roller and heater assembly constituting a part of an apparatus according to the invention;

Fig. 5 is similar to Fig. 4 but shows another roller and heater assembly;

Fig. 6 is a top view of the material shown in Fig. 2;

Fig. 7 is a schematic sectional view showing the material of Fig. 6 as being in roll form;

Fig. 8 is a schematic sectional view illustrating a final step in the method according to the invention;

Fig. 9 is a side sectional view of a part of an embodiment of an apparatus according to the invention;

Fig. 10 is a perspective view of the apparatus shown in Fig. 9;

Fig. 11 is a partial side sectional view showing a modification of the apparatus shown in Fig. 9;

Fig. 12 is a side sectional view of a cam assembly constituting a modification of part of the apparatus shown in Fig. 9; and

Fig. 13 is a partial side view further illustrating the step shown in Fig. 8.

Figs. 1 and 2 illustrate the basic method of the invention. A composite material (no numeral) is provided by applying a release layer B to a heat resistant backing layer A, and then forming a transparent thermal bonding layer C on top of the release layer B. A sheet D, which may be a photograph, is placed in contact with the composite material thus formed so that the surface to be protected, in the case of a photograph the emulsion surface, is in face to face contact with the thermal bonding layer C. The sheet D and the composite material are then fed through a roller and heater assembly comprising a hollow pressure roller 38, a backing roller 10 and a heater 22 arranged inside the roller 38. In this manner, the thermal bonding layer C is heated under pressure and bonds to the sheet D to constitute a protective coating. Due to the provision of the release layer B the backing layer A and the release layer B may be separated from the sheet D and bonding layer C so that the bonding layer C only adheres to the sheet D, as is clearly shown in Fig. 2. The composite material formed in an intermediate step of the method is preferably in roll form, and may have sprocket holes 1*a* (see Fig. 10) formed through one or both edge portions. The sheet D may be either in the form of individual sheets or in the form of a roll. In addition, the bonding layer C may be either applied to the entire surface of the backing layer A and release layer B, or only onto selected portions thereof. The latter case is illustrated in Fig. 3 where the bonding layer C is arranged to cover a portion enclosed by a broken line C′ of an identification card 20, or a portion enclosed by a broken line C″ corersponding to a photograph adhered to the identification card 20. The sheet D will herein be considered as being in the form of the card 20. As shown in Fig. 6, portions C′ of Fig. 3 are shown as being equally spaced on the backing layer A.

The heat resistant backing layer A may be formed of a suitable material such as polypropylene, an acetate or a fluoro carbon resin. The release layer B may be formed of a silicone resin or an acrylic resin. The thermal bonding layer C is of polyvinyl chloride, polyvinyl acetate or a polyamide.

As shown in Fig. 1, the roller 38 is hollow, and the heater 22 is disposed inside the roller 38. Alternative arrangements are shown in Figs. 4 and 5. In Fig. 4, the heater 22 comprises a heating element 21 which may be, for example, a nichrome wire or an infra-red lamp. A curved reflector 24 is employed to direct heat from the heating element 21 onto the outer surface of a modified hollow pressure roller 11, here shown as solid. It is desirable to have the circumference of the rollers 11 or 38 larger than the length of the card 20 to minimize heat loss. The roller 11 may be made of a heat insulating material such as silicone rubber, and the roller 38 may be made of a heat conductive material such as aluminium or copper. In Fig. 5, the heater 22 is arranged to heat the bonding layer C before the card 20 and the composite material are fed between the rollers 10 and 11. Although not shown, one or more heaters 22 may be arranged to heat both the rollers 10 and 11.

Fig. 7 shows the card 20 and the composite material in a position to be fed between the rollers 10 and 11, and Fig. 8 shows the same after feeding between the rollers 10 and 11. Numeral 4 designates one roller of a first feed roller assembly which will be described later. In Fig. 8, it will be seen that a trim portion C‴ has adhered to the release layer B because the corresponding portion C′ was provided slightly oversize. In this case, burrs (not shown) of the bonding layer C material may adhere to the edges of the card 20. However, it has been found on

practice that such burrs can be easily removed by hand.

Figs. 9 and 10 show an apparatus for applying the composite material onto the card 20. The composite material is provided in the form of a roll 1 mounted on a reel 2, and is passed around the roller 4 and a roller 5 of a second feed roller assembly and finally onto a take-up reel 6. The rollers 4 and 5 are provided with sprockets 4*a* and 5*a* respectively to engage in the sprocket holes 1*a*. Rollers 7 and 8 are provided in conjunction with the rollers 4 and 5 respectively. The composite material has a working portion 3, a tension portion 9 and a backing portion 35 as will be described below. The rollers 4 and 5 maintain the tension portion 9 of the composite material in a state of tension so that wrinkles do not occur when the bonding layer C is adhered to the card 20 and cooled. A keeper plate 33, a receiving table 34 and a guide member 32 having an inlet slot 32*a* to receive the card 20 are also shown, and will be described in detail below.

The rollers 10 and 11 are respectively mounted on shafts 10*a* and 11*a* with the second roller 10 arranged vertically above the first roller 11. A container or box 12 is provided with vertical slots 12*a* (only one is visible in the drawings), a rail groove 12*b* at its top portion and a cover or lid 23 slidable in the rail groove 12*b* to open or close the box 12. The roller 11 is disposed in the box 12 with the ends of its shaft 11 vertically slidable in the grooves 12*a*. The heater 22 is located below the roller 11 to heat the surface thereof. A mechanism comprising a first or bell-crank lever 13, a second lever 26 and a cam 18 are provided to move the roller 11 from a standby position shown in Fig. 9 in which the lid 23 is closed to an operating position shown in Fig. 10 in which the lid 23 is open. The first lever is pivotable about a shaft 15, and has a slot 13a formed through one arm thereof and the other arm fixed to a shaft 16. A similar lever 13 is provided on the other side of the apparatus, but is not visible in the drawings. The ends of the shaft 11*a* are slidable in the slots 13*a* of the levers 13.

A bent portion 23*a* of the lid 23 has a pin 25 fixed thereto. The second lever 26 is pivotable about a shaft 28 and has a slot 26*a* formed through one arm in which the pin 25 is slidable. A similar slot 26*b* is formed through the other end of the lever 26, and a pin 30 fixed to the cam 18 is slidable in the slot 26*b*. The cam 18 is shown as being eccentrically mounted on a drive shaft 17, which may be rotated by means of an electromagnetic or spring clutch (not shown). If the heater 22 is small, the roller 11 may be rotated slowly in the standby position by means such as a capstan roller (not shown) to heat the entire surface thereof. The box 12 may be made of stainless steel and lined with asbestos.

In operation, the card 20 is fed through the guide member 32 toward the rollers 10 and 11. When the card 20 reaches a presynchronized position, a switch (not shown) is closed to rotate the take-up reel 6 and the feed rollers 4 and 5 to move the composite material through the apparatus. Simultaneously, the cam drive shaft 17 is rotated clockwise by 1/2 turn. The surface of the cam 18 thus moves the shaft 16 leftward as shown in Fig. 9 so that the first lever 13 is rotated clockwise and the roller 11 is moved upward to the operating position shown in Fig. 10 in which is protrudes from the box 12 and is adjacent to the roller 10. Simultaneously, the second lever 26 is also rotated clockwise and the lid 23 is moved rightward as shown in Fig. 9 to the open position of Fig. 10. The card 20 is then fed in face to face contact with the coating material between the rollers 10 and 11 which apply heat and pressure thereto to bond the bonding layer C to the card 20. The card 20 carrying the bonding layer C then passes between the rollers 5 and 8 and is ejected onto the receiving table 34. At this point, another switch (not shown) is actuated to stop the transport of the composite material and cause the drive shaft 17 to be rotated counterclockwise by turn. This results in the first and second levers 13 and 26 respectively rotating counterclockwise to lower the roller 11 to the standby position and close the lid 23 to prevent loss of heat from the box 12. If desired, the slots 12*a* of the box 12 may be provided with slide shutters (not shown) which are operated by the shaft 11*a*. Also, the lid 23 may be opened and closed by means of a wire or equivalent means (not shown). The cam 18 and levers 13 and 26 may be omitted entirely if the card 20 is sufficiently thick, and an opening (not shown) is provided through the top of the lid 23 through which the roller 11 slightly protrudes. It will be appreciated that the apparatus shown in Figs. 9 and 10 is very economical in that the roller 11 is stored in the box 12 when not in use, and that a considerable saving of energy can be accomplished.

Fig. 11 shows an alternative form of the roller 38, which is mounted within a cylindrical box 36. The heater 22 is disposed inside the roller 38 as before, and the roller 38 is movable vertically by means of slots (not shown) and a mechanism similar to that of Figs. 9 and 10. The box 36 has semi-circular grooves 36*a* in which a semi-

cylindrical lid 37 is slidable to open and close the box 36. The lid 37 may be actuated by for example a cable or linkage (not shown).

Fig. 12 shows an alternative form of the cam 18, here designated as 18', which has a non-circular profile.

Fig. 13 illustrates how the card 20 and bonding layer C are separated from the backing layer A and release layer B. The backing portion 35 comprising the backing layer A and the release layer B are pulled downward around the roller 5 by means of the sprocket 5*a* and sprocket holes 5*a*. The keeper plate 33, however, applies a normal force to the upper face of the card 20, and due to the releasing effect of the release layer B and the stiffness of the card 20 and bonding layer C, the card 20 and bonding layer C move rightward as shown in Fig. 13 to separate from the backing portion 35 and be ejected onto the receiving table 34.

WHAT WE CLAIM IS:—

1. A method of applying a transparent protective coating to a sheet, comprising:

(a) preparing a composite material by forming a release layer on a heat resistant backing layer and then releasably adhering a transparent thermal bonding layer onto the release layer, the thermal bonding layer comprising a material selected from polyvinyl chloride, polyvinyl acetate and a polyamide;

(b) maintaining the composite material thus formed in a state of tension;

(c) placing the said sheet and the said composite material together so that the thermal bonding layer is in face-to-face contact with the sheet;

(d) applying heat and pressure to bond the thermal bonding layer to the sheet; and

(e) separating both the heat resistant backing layer and the release layer from the thermal bonding layer so that the thermal bonding layer remains bonded to the sheet to constitute a transparent protective coating on the sheet.

2. A method as claimed in Claim 1, in which the heat resistant backing layer is a fluoro carbon resin or a silicone resin.

3. A method as claimed in Claim 1, in which the heat resistant backing layer is polypropylene, an acetate or a fluoro carbon resin.

4. A method as claimed in any of Claims 1 to 3, in which the release layer is a silicone resin or an acrylic resin.

5. A method as claimed in any of Claims 1 to 4, in which the said maintaining step (b) is effected in a positive manner utilizing engaging elements engaging spaced openings in the said composite material.

6. A method as claimed in any of Claims 1 to 5, in which the said separating step (e) comprises applying a force to the coated sheet in a direction perpendicular to the general plane of the coated sheet, the said force being applied to the coated sheet at a location just preceding the actual separation of the heat resistant backing layer and release layer from the thermal bonding layer, whereby the said applied force facilitates separation of the backing layer and release layer from the thermal bonding layer.

7. A method as claimed in any of Claims 1 to 6, in which the said composite material is maintained in a state of tension by providing the composite material with spaced sprocket holes and passing the composite material over the rollers having sprocket wheels with sprockets engaging the sprocket holes, the said separating step (e) being effected by passing the heat resistant backing layer and release layer along an arcuate path by-passing at least partially about one of the said rollers having sprocket wheels, and applying a force normal to t he general plane of the coated sheet just before the backing layer and release layer pass over the said one roller such that the said normal force applied to the coated sheet tends to maintain a generally straight line path of travel for the coated sheet as the release layer travels along the said arcuate path over the said one roller, whereby the said applied normal force facilitates separation of the backing layer and release layer from the thermal bonding layer.

8. A method as claimed in Claim 7, in which the said sheet on which the protective coating is applied is a card which is relatively stiff such that the said normal force applied to the card prevents the card from following the arcuate path of the backing layer and release layer.

9. A method as claimed in any of Claims 1 to 8, in which the said sheet on which the protective coating is applied comprises cards and the heat resistant backing layer is an elongate web, the said cards being fed and placed into face-to-face contact with the said composite material intermittently, and the said heat and pressure being applied intermittently in synchronism with the feeding of the said cards.

10. A method of applying a transparent protective coating to a sheet, substantially as herein described with reference to the accompanying drawings.

11. A sheet to which a transparent protective coating has been applied by the method as claimed in any of Claims 1 to 10.

12. Apparatus for applying a transparent protective coating to a sheet, com-

prising: (a) first means for preparing a composite material by forming a release layer on a heat resistant backing layer and then releasably adhering a transparent thermal bonding layer onto the release layer; (b) second means for maintaining the composite material thus formed in a state of tension; (c) third means for placing the said sheet and the said composite material together so that the thermal bonding layer is in face-to-face contact with the sheet; (d) fourth means for applying heat and pressure to bond the thermal bonding layer to the sheet; and (e) fifth means for separating both the heat resistant backing layer and the release layer from the thermal bonding layer so that the thermal bonding layer remains bonded to the sheet to constitute a transparent protective coating on the sheet

13. Apparatus as claimed in Claim 12, in which the fourth means is a roller and heater assembly comprising first and second rollers arranged to compress the sheet and the composite material when fed therebetween by the third means, and a heater.

14. Apparatus as claimed in Claim 13, in which the third means comprises a first feed roller assembly for feeding the sheet and the composite material into the said roller and heater assembly.

15. Apparatus as claimed in Claim 13 or 14, in which the fifth means comprises a second feed roller assembly for removing the sheet and the composite material from the said roller and heater assembly and for urging the backing layer in one direction and the sheet with the thermal bonding layer adhered there to in another direction to separate the backing layer from the sheet and bonding layer.

16. Apparatus as claimed in Claim 15, in which the second feed roller assembly further comprises a keeper plate to apply a normal force to the sheet and composite material.

17. Apparatus as claimed in Claim 15 or 16 when appendant to Claim 14, in which a roller of each of the first and second feed roller assemblies has sprockets to engage in sprocket holes formed through an edge portion of the composite material.

18. Apparatus as claimed in any of Claims 13 to 17, in which the heater is arranged to heat the thermal bonding layer before the sheet and composite material are fed between the first and second rollers.

19. Apparatus as claimed in any of Claims 13 to 17, in which the heater is arranged to heat the first roller.

20. Apparatus as claimed in Claim 19, in which the heater is arranged adjacent the first roller to heat the circumference of the first roller.

21. Apparatus as claimed in Claim 19, in which the first roller is hollow and the heater is arranged inside the first roller.

22. Apparatus as claimed in Claim 19, in which the roller and heater assembly further comprises a thermally insulated box and the second roller is arranged vertically above the first roller, whereby the first roller is movable from a standby position inside the box to an operating position adjacent the second roller in which a portion of the first roller protrudes from the box.

23. Apparatus as claimed in Claim 22, in which the box has a lid, and in which the roller and heater assembly further comprises a mechanism for opening the lid and moving the first roller into the operating position, and for moving the first roller into the standby position and for closing the lid.

24. Apparatus as claimed in Claim 23, in which the first roller is fixed to a shaft, the ends of which are movable in vertical slots formed through the sides of the box and the lid has a pin fixed thereto, and in which the mechanism comprises a first lever having an intermediate pivot point and one end engageable with the shaft to move the ends of the shaft vertically in the slots, a cam engaging with the other end of the first lever to rotate the first lever, the cam having a pin fixed thereto, and a second lever having an intermediate pivot point and being engageable at its opposite ends with the pins of the lid and the cam respectively, whereby when the cam is at a first position the first roller is moved to the standby position by the first lever and the lid is closed by the second lever, and when the cam is at a second position the first roller is moved to the operating position by the first lever and the lid is opened by the second lever.

25. Apparatus for applying a transparent protective coating to a sheet, substantially as herein described with reference to, and as shown in, the accompanying drawings.

MARKS & CLERK.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1977.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1 472 802 COMPLETE SPECIFICATION
4 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

Fig. 1

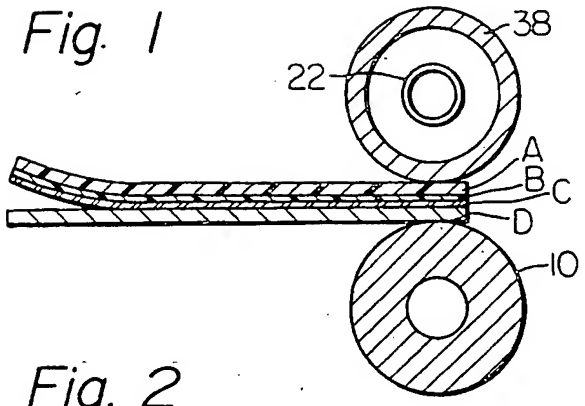


Fig. 2

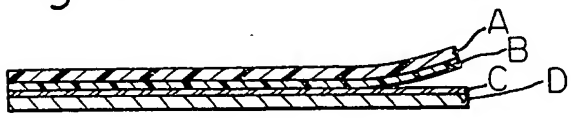


Fig. 3

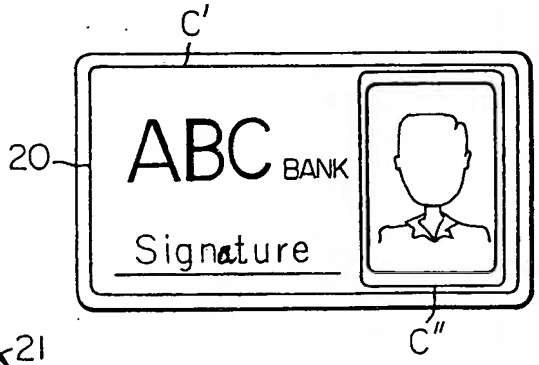


Fig. 4

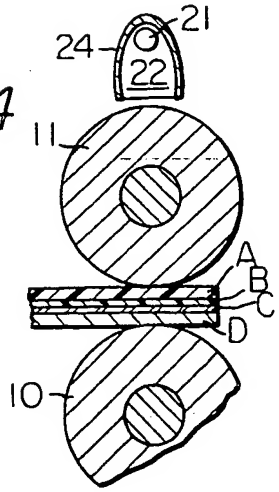


Fig. 5

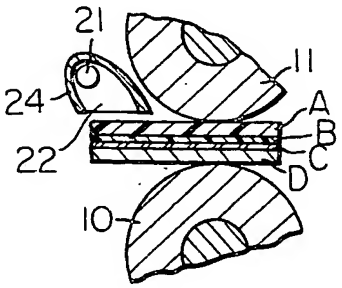


Fig. 6

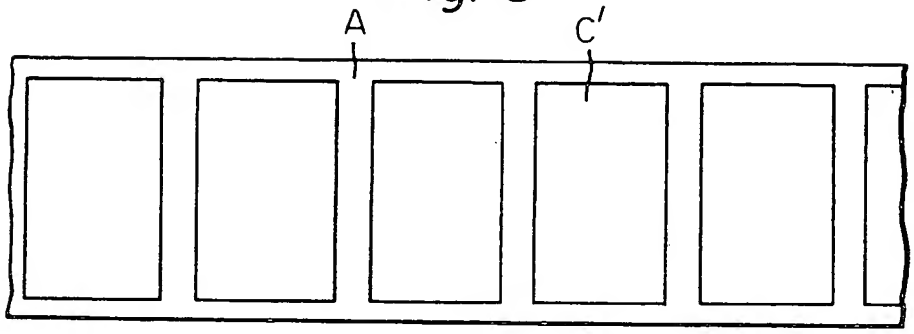


Fig. 7

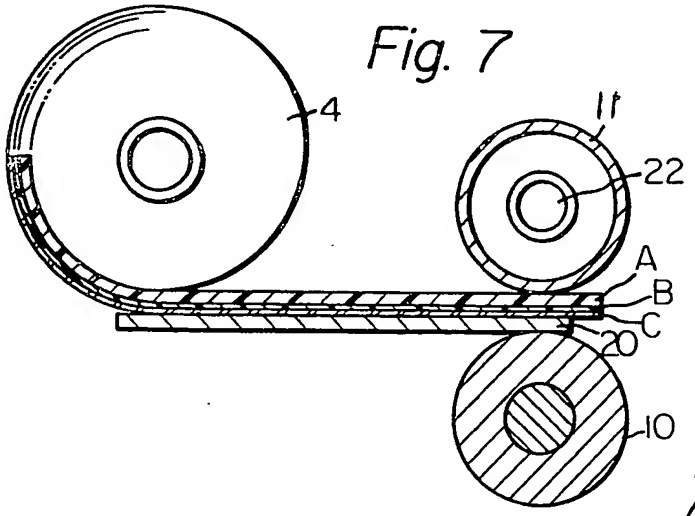


Fig. 8

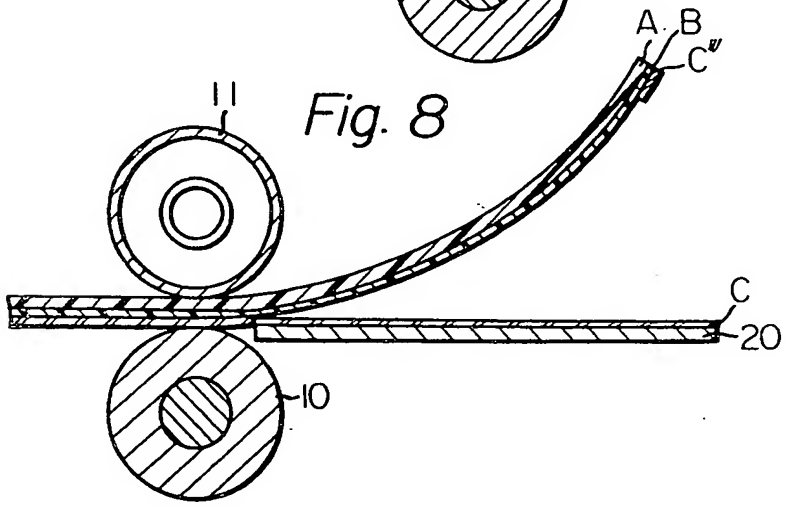
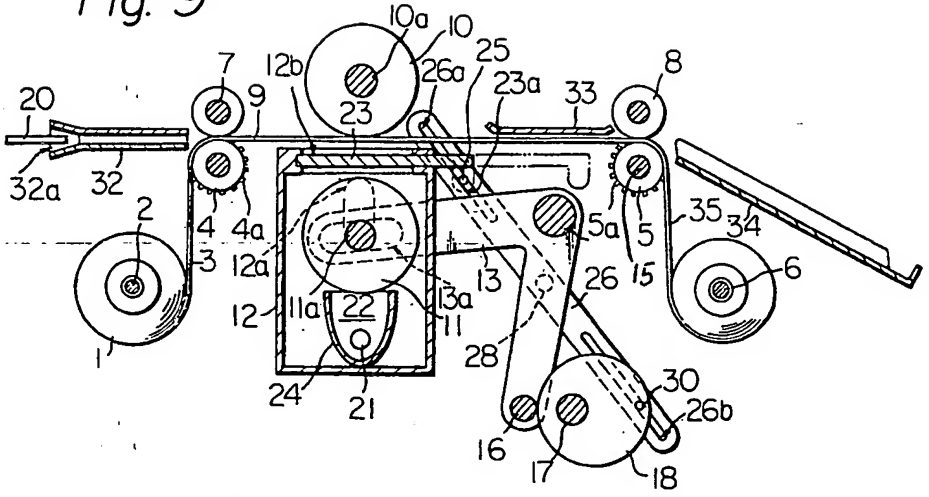


Fig. 9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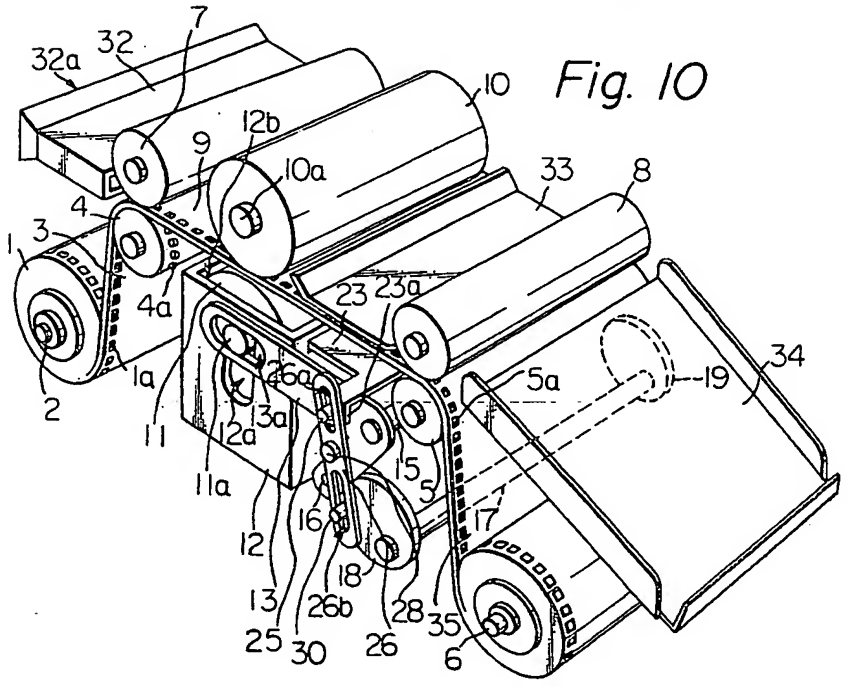
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Fig. 10

Fig. 11

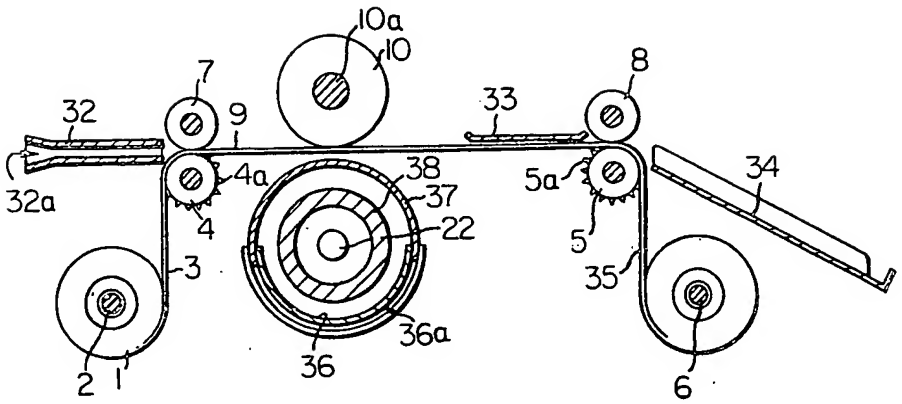

Fig. 12

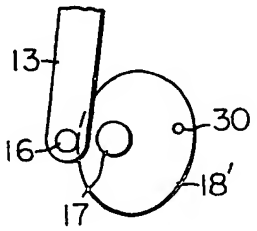

Fig. 13